(12) UK Patent Application (19) GB (11) 2 176 878 A

(43) Application published 7 Jan 1987

(21) Application No 8025515

(22) Date of filing 8 Aug 1980

(30) Priority data

(31) 7928218 (32) 14 Aug 1979 (33) GB

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(51) INT CL^4
F42B 1/02 // C06B 25/34

(52) Domestic classification (Edition I):
F3A C1A1 C1A3
C1D 6A2A 6A2J 6BX
U1S 1650 2316 F3A

(56) Documents cited

GB 1256255	GB 0658625
GB 1046655	US 4080898
GB 0968507	US 3763784
GB 0890096	US 3721192
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(58) Field of search
F3A
Selected US specifications from IPC sub-class F42B

(54) Hollow charges

(57) In a hollow charge, particularly a linear cutting charge a bar 1 formed from a composite of explosive material and a first plastic material has a V-shaped groove 2 with a liner 5 formed from a composite of metal and a second plastic material. The metal may be copper and preferably the first and second plastic materials include the same constituents, e.g. polyisobutylene, 2(diethylhexyl)sebacate and PTFE. The linear cutting charge may include a casing 6 having a spacing portion 7, 8 to maintain an optimum stand-off distance. The casing 6 may further include metallic stiffening strips 14, 15 and a groove filling portion 17 of low density material which may be integrally constructed with the casing from a flexible material such as expanded polyethylene. Alternatively the casing 6 may be of rigid polystyrene or the portion 17 may be a thin walled air filled compartment.

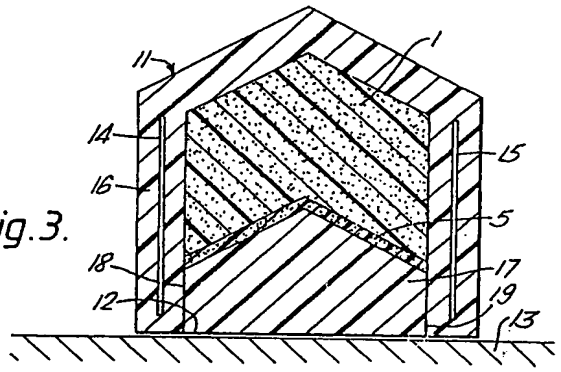

Fig.3.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

Fig.1.

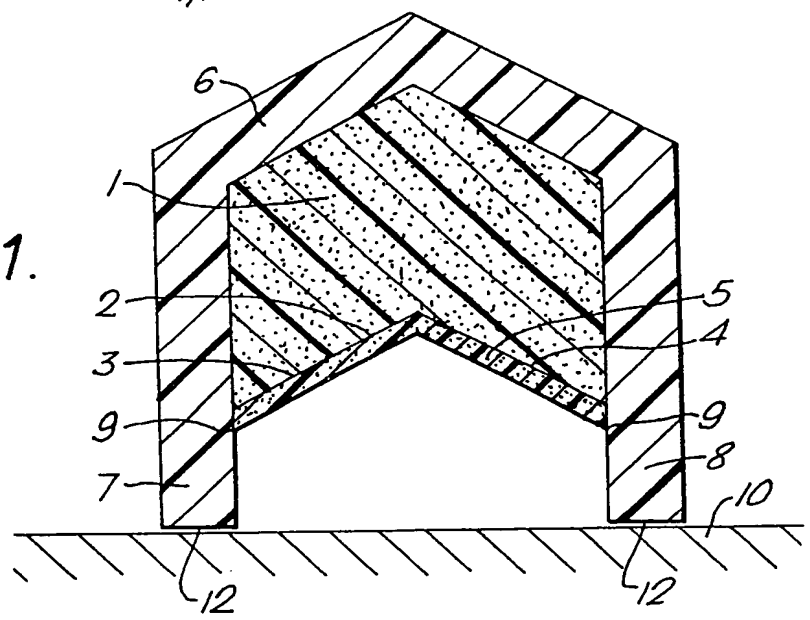


Fig.2.

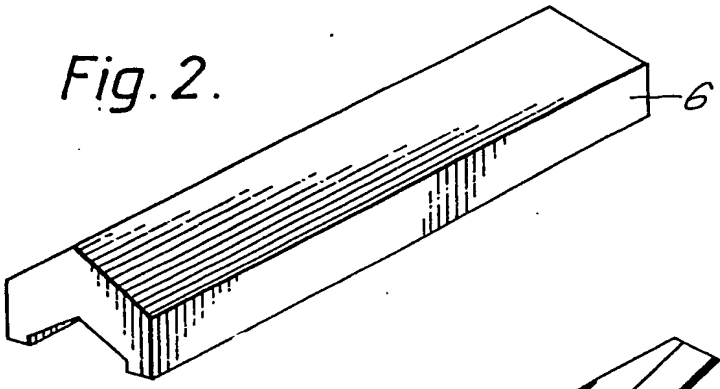
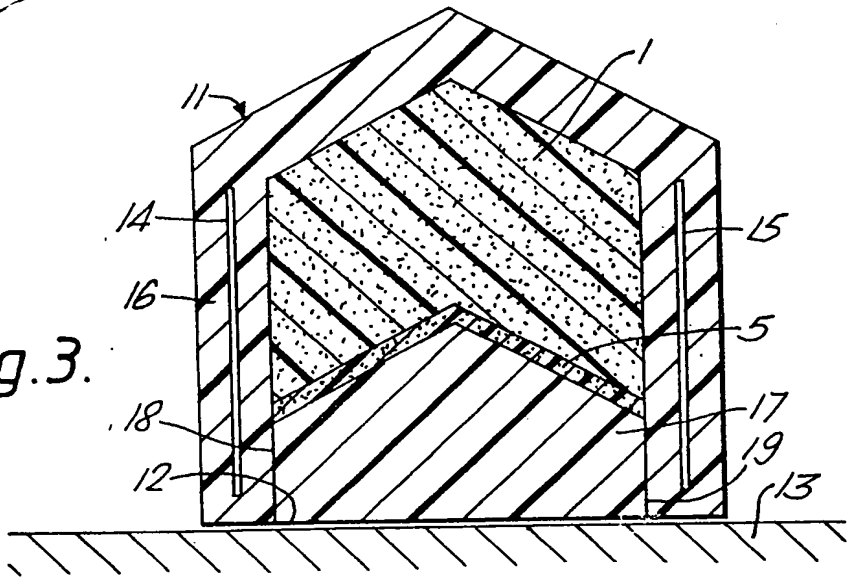


Fig.3.



SPECIFICATION

Hollow charges

This invention relates to hollow charges and in particular, but not exclusively, to a linear cutting charge.

Hollow charges are known comprising a mass of explosive having a variously shaped cavity at one of its surfaces, the cavity being lined with a metal liner. Detonation of the charge violently compresses the metal liner converting it into an outwardly projecting jet of molten metal, the shape of which is dependent upon the shape of the cavity. The jet has powerful penetrating properties which are utilized by detonating the charge with its cavity adjacent and facing a surface to be penetrated ie the work surface. The penetration of the charge is dependent on its separation from the work surface, ie the stand-off distance, the optimum value of which is normally determined by experiment.

One particular example of a hollow charge is a linear cutting charge comprising an elongated mass of explosive material having a cavity in the form of a V-shaped groove along its length which mass is encased by a thin walled metal casing. Detonation produces a planar jet along the length of the groove which can be utilized for linear cutting purposes. In a known method of manufacture of such linear cutting charges, a lead tube is packed with explosive granules and then passed through a series of rollers arranged to form the packed tube into a bar of chevron cross-section thereby forming a lead-lined, V-shaped groove along the length of the bar. The thickness of the lead wall encasing the two outer apices of the V-shaped groove is relied upon to space the charge from the work surface and thus defines the stand-off distance. Linear cutting charges so produced often have a non-uniform wall thickness and when these non uniformities occur at the stand-off region or in the lining of the groove, variations in cutting efficiency and a lack of uniformity in cutting power results.

The present invention seeks to provide a hollow charge such as a linear cutting charge having a construction conducive to accurate and uniform formation of its effective dimensions.

According to the present invention a hollow charge includes an explosive mass formed from a composite of explosive material and a first plastic material, the mass having a cavity in one of its faces, and a liner formed from a composite of metal and a second plastic material located within the cavity.

The metal may advantageously be copper.

The first and second plastic materials are chosen to be chemically compatible with the explosive material and are preferably identical. When the hollow charge is for use as a cutting charge, the explosive mass may be formed in a shape corresponding to the desired cut. In particular, the explosive means of a linear cutting charge may be a bar having a longitudinal V-shaped groove comprising the cavity.

Preferably, both the bar and the liner are of chevron cross-section, the liner being bonded to the bar so as to cover the surfaces of the V-shaped groove.

Preferably the linear cutting charge further includes a casing which may advantageously be substantially rigid to prevent distortion of the bar and the liner during handling, which casing may advantageously include a spacing portion having an engagement surface for presentation to a work surface, which engagement surface is parallel to the outer edges of the liner and spaced therefrom thereby to maintain an optimum stand-off distance. Alternatively the casing may be flexible to facilitate cutting of curved surfaces and curved lines.

A flexible linear cutting charge having a flexible casing may advantageously include stiffening means which may comprise metallic strips embedded in the casing normal to the engagement surface and extending longitudinally on either side of the groove whereby the bending of the linear cutting charge may be limited to lateral bending parallel with the engagement surface.

The presence of dense material in the cavity is detrimental to cutting efficiency and therefore the casing may advantageously include a groove filling portion of low density material to prevent the influx of dense material when, for example, the linear cutting charge is used under water.

Conveniently, the casing including the spacing portion and the groove filling portion may be integrally constructed from a low density flexible material such as expanded polyethylene.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings of which

Figure 1 is a transverse section of a flexible linear cutting charge,

Figure 2 is an oblique view of the whole linear cutting charge of Figure 1 and

Figure 3 is a transverse section of a flexible linear cutting charge having stiffening means.

The linear cutting charge of Figures 1 and 2 has an explosive bar 1 of chevron cross-section having a groove 2 defined by the intersecting surfaces 3 and 4 which are inclined one to the other at an angle of 120 degrees.

The bar 1 is formed by extrusion from a mixture of 88% by weight of RDX (Cyclotrimethylenetrinitramine), 8.4% PIB (Polyisobutylene), 2.4% DEHS (2 (Diethylhexyl)sebacate), and 1.2% PTFE (polytetrafluroethylene) and is itself plastic.

The thickness of the bar measured in a direction normal to either of the faces 3 or 4 is 6.35 mm. A V-section liner 5 of 0.635 mm thickness formed by extrusion from a plastic mixture of 85% by weight of 300 mesh copper powder and 5.6% PIB, 1.6% DEHS and 7.8% PTFE is bonded to the surfaces 3 and 4 by pressure.

A flexible casing 6 of expanded polyethylene surrounds the bar 1 except for the groove 2 and includes spacing portions 7 and 8 which protrude beyond the edges 9 of the liner 5 by a distance of 3.8 mm which is the optimum stand-off distance for this configuration between the edges 9 and an

engagement surface 12 presented to a work surface 10. The casing 6 and the bar 1 are bonded together by a suitable adhesive.

The explosive bar 1 may conveniently be initiated by an electrically operated detonator (not shown) which may be affixed externally to the casing at one end of the linear cutting charge.

A second embodiment of the invention is illustrated in Figure 3 in which the bar 1 and liner 5 described with reference to Figures 1 and 2 are surrounded entirely by a casing 11 of a low density material such as expanded polyethylene having an engagement surface 12 which is placed in contact with a work surface 13. The casing 11 comprises a first portion 16 which is substantially the same as the casing 6 of Figure 1 and a groove filling portion 17 which is bonded to the first portion 16 at surfaces 18 and 19 by a suitable adhesive.

Stiffening means comprising metallic strips 14 and 15 are embedded in the casing 11 on either side of the groove 2 and normal to the engagement surface 12 thereby limiting bending of the linear cutting charge to lateral bending parallel to the plane of the engagement surface 12.

It will be apparent to those skilled in the art that various other arrangements of the present invention are possible. For example, a casing may be of a rigid material such as polystyrene and any casing may or may not include a groove filling portion. A groove filling portion may alternatively comprise a thin walled air filled compartment thereby excluding material from the groove and providing minimal resistance to the action of the hollow charge.

CLAIMS

1. A hollow charge including an explosive mass formed from a composite of explosive material and a first plastic material, the mass having a cavity in one of its faces, and a liner formed from a composite of metal and a second plastic material located within the cavity.

2. A hollow charge as claimed in claim 1 wherein the metal is copper.

3. A hollow charge as claimed in claims 1 and 2 wherein the first plastic material and the second plastic material have the same constituents.

4. A hollow charge as claimed in claim 3 wherein the constituents are PIB (Polyisobutylene), DEHS (2 (Diethylhexyl) sebacate), and PTFE (polytetrafluroethylene).

5. A hollow charge as claimed in any of the previous claims including a casing open at the cavity and having an engagement surface peripheral to the cavity, which engagement surface is presented in use to a work surface.

6. A hollow charge as claimed in claim 5 wherein the casing extends beyond the cavity to produce a spacing portion whereby the engagement surface is spaced from the outer edges of the liner by a predetermined stand-off distance.

7. A hollow charge as claimed in claims 5 and 6 wherein the casing includes a cavity filling portion of a low density material.

8. A hollow charge as claimed in claim 7 wherein the cavity filling portion and the casing are of integral construction.

9. A hollow charge as claimed in any of the preceding claims wherein the explosive mass is a bar having a longitudinal V-shaped groove comprising the cavity.

10. A hollow charge as claimed in claim 9 wherein both the bar and the liner are of chevron cross-section.

11. A hollow charge as claimed in any of claims 5 to 10 wherein the casing is substantially rigid.

12. A hollow charge as claimed in any one of claims 5 to 10 wherein the casing is flexible.

13. A hollow charge as claimed in claim 12 including stiffening means whereby bending of the bar is substantially limited to lateral bending parallel with the engagement surface.

14. A hollow charge as claimed in claim 13 wherein the stiffening means comprises metal strips embedded in the casing normal to the engagement surface and extending longitudinally on either side of the groove.

15. A hollow charge as claimed in any of claims 12 to 14 wherein the casing is of expanded polyethylene.

16. A hollow charge substantially as hereinbefore described with reference to the accompanying Figures 1 and 2.

17. A hollow charge substantially as hereinbefore described with reference to the accompanying Figure 3.

Printed in the UK for HMSO, D8818935, 11/86, 7102.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.